Searching PAJ

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 05-113561
(43)Date of publication of application : 07.05.1993

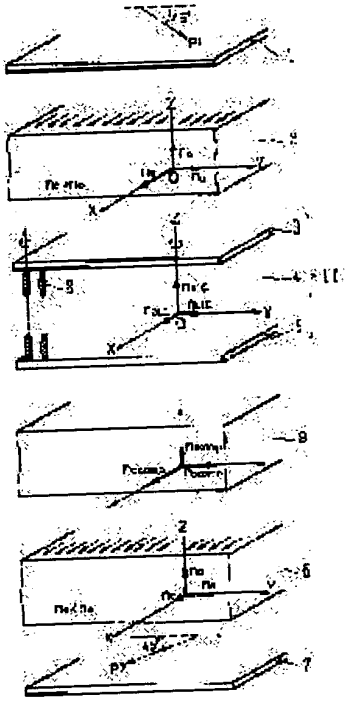
(51)Int.CI. G02F 1/1335
G02B 5/30

(21)Application number : 03-272852
(22)Date of filing : 21.10.1991

(71)Applicant : STANLEY ELECTRIC CO LTD
(72)Inventor : JIYAN FUREDERITSUKU KUREERU
HIROSE SHINICHI

(54) PERPENDICULAR ORIENTATION TYPE LIQUID CRYSTAL DISPLAY DEVICE

(57)Abstract:
PURPOSE: To provide an optical compensating means for expanding the visual field angle of the perpendicular orientation type liquid crystal display device in which liquid crystal molecules are arranged perpendicularly to substrates.
CONSTITUTION: This display device has a liquid crystal cell (10) which has positive optical activity with the direction perpendicular to the substrates 3, 5 as its optical axis, the optical compensating means 9 which has negative optical activity with the direction perpendicular to the plane as its optical axis, a 1st retardation plate 2 which has positive optical axis with one direction within the plane parallel with the substrates 3, 5 as its optical axis and generates a phase difference of nearly a quarter wavelength, a 1st polarizer 1 which has the axis of polarization in the direction having nearly 45° with the optical axis of the 1st retardation plate 2, a 2nd retardation plate 6 which has negative optical activity with the direction nearly parallel with the optical axis of the 1st retardation plate 2 as its optical axis and generates a phase difference of a nearly quarter wavelength, and a 2nd polarizer 7 which has the axis of polarization in the direction nearly orthogonal with the axis of polarization of the 1st polarizer.



LEGAL STATUS

[Date of request for examination] 13.10.1992
[Date of sending the examiner's decision of rejection] 24.10.1995
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]
[Date of final disposal for application]
[Patent number]
[Date of registration]
[Number of appeal against examiner's decision of rejection]
[Date of requesting appeal against examiner's decision of rejection]
[Date of extinction of right]

CLAIMS

[Claim(s)]
[Claim 1] The perpendicular array-type liquid crystal display characterized by providing the following. The liquid crystal cell which has the positive optical activity to which a nematic liquid crystal arranges to a perpendicular mostly at a substrate, and uses a direction perpendicular to a substrate as an optical axis in the state where electric field are not impressed. An optical compensation means to have the negative optical activity which adjoins a liquid crystal cell, is arranged and uses a direction perpendicular to a field as an optical axis. The 1st retardation board which it is arranged [board] at one aforementioned liquid crystal cell side, has [board] the positive optical activity within a field parallel to the aforementioned substrate which uses ** as an optical axis on the other hand, and produces the phase contrast of wavelength mostly (1/4). The 1st polariscope which is arranged outside the 1st retardation board and has a polarization shaft in a field parallel to the aforementioned substrate in the direction which makes the optical axis of the aforementioned 1st retardation board, and the angle of about 45 degrees, It is arranged at the another side side of the aforementioned liquid crystal cell, and has the negative optical activity which uses an almost parallel direction as an optical axis to the optical axis of the aforementioned 1st retardation board in a field parallel to the aforementioned substrate. The 2nd polariscope which has a polarization shaft in the direction which is arranged outside the 2nd retardation board which produces the phase contrast of wavelength mostly (1/4), and the aforementioned 2nd retardation board, and intersects perpendicularly with the polarization shaft of the 1st polariscope of the above mostly in a field parallel to the aforementioned substrate.
[Claim 2] The optical compensator for liquid crystal displays characterized by providing the following. Central structure including an optical compensation means to have the negative optical anisotropy which uses as an optical axis a direction perpendicular to the substrate and field of the couple which demarcates the space in which liquid crystal can be held. It is a phase shift means to have the negative optical activity which uses as an optical axis the direction where another side is parallel to the one aforementioned direction by one side having the positive optical activity within a field which uses ** as an optical axis on the other hand with the board of the optically uniaxial optical medium of the couple arranged on the aforementioned central structure.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to the compensation means for expanding the angle of visibility of the perpendicular array-type liquid crystal display which especially a liquid crystal molecule arranges at right angles to a substrate about a liquid crystal display.
[0002]
[Description of the Prior Art] As a kind of a liquid crystal display, the HOMEOTORO pick liquid crystal display which the liquid crystal molecule arranged mostly to the substrate at the perpendicular is known. For example, a rectangular polarizer is arranged on both sides of a HOMEOTORO pick liquid crystal cell.
[0003] In the OFF state by which voltage is not impressed to a liquid crystal cell, without being influenced in a liquid crystal cell, the light which penetrated one polarizer reaches the polarizer of another side, and is intercepted by the rectangular polarizer.
[0004] However, although it is satisfactory in the case of a perpendicular light, if an incident angle increases to a substrate, the light by which the polarization state of an incident light is influenced by the form birefringence of liquid crystal, and should be intercepted will come to penetrate the polarizer of another side. For this reason, the contrast of an ON state and an OFF state falls and it comes to produce even reversal of monochrome state further.
[0005] For this reason, the angle of visibility of the perpendicular array-type liquid crystal display which the liquid crystal molecule arranged to the perpendicular mostly on the substrate front face will be restricted remarkably. In order to expand an angle of visibility, using an optical compensating plate is proposed.
[0006] Drawing 3 shows one gestalt of optical compensation of a perpendicular array-type liquid crystal display. In drawing 3 , the liquid crystal cell 12 constituted using the substrate 13, the liquid crystal layer 14, and the substrate 15 is arranged following the polariscope 11 by the side of incidence, the optical compensating plate 16 is arranged in parallel with this liquid crystal cell 12, and the outgoing radiation side polariscope 17 is arranged. Polariscopes 11 and 17 constitute the rectangular cross linear polariscope by which rectangular arrangement was carried out.
[0007] The liquid crystal molecule 18 is the refractive index neLC high in the direction of a major axis. It has and is the low refractive index noLC homogeneous within a flat surface perpendicular to a major axis. It has. Here, it is a refractive index ne. Refractive index no neLC >noLC which has a large value. It is formed in the direction perpendicular to a substrate by the optically uniaxial optical medium which has an optical axis, and the optical compensating plate 16 is the refractive index necomp of the direction of an optical axis. Refractive index nocomp of field inboard necomp <nocomp chosen small.
[0008] That is, the liquid crystal layer 14 has positive optical activity, and the optical compensating plate 16 has negative optical activity. Optical activity positive [these] and negative optical activity compensate mutually, and expand the angle of visibility of a liquid crystal display as a result.
[0009] In the composition shown in drawing 3 , a refractive index needs to use a low optical medium in the membranous thickness direction. Such an optical medium still has a problem in a manufacturing process, and cannot be mass-produced easily.
[0010] Drawing 4 shows other gestalten of an optical compensation mechanism. Substrates 13 and 15 constitute a liquid crystal cell on both sides of the liquid crystal layer 14, the optical compensating plates 22 and 26 are arranged on the outside, and polariscopes 21 and 27 are arranged further on the outside. The liquid crystal cell 12 is the same as that of the liquid crystal cell shown in drawing 3 , and in the state where electric field are not impressed, the liquid crystal molecule 18 is mostly arranged by substrates 13 and 15 at a perpendicular, and has positive optical activity.
[0011] The optical compensating plate 22 has the optical anisotropy of optically biaxial, and the refractive indexes n1, n2, and n3 have the relation of n1>n2>n3. The shaft which has the smallest refractive index n3 is arranged in the

thickness direction of the optical compensating plate 22, and the shaft (y-axis) which has the biggest refractive index n1, and the shaft (x axis) which has the refractive index n2 big next are arranged at the field inboard of the optical compensating plate 22.

[0012] Other optical compensating plates 26 consist of optically-biaxial media which have the refraction train of n1>n2>n3 like the optical compensating plate 22, and the shaft which has the smallest refractive index n3 is arranged in the thickness direction of the optical compensating plate 26.

[0013] Moreover, the shaft orientations which have the 2nd refractive index n2 of the optical compensating plate 26 in y shaft orientations by which the refractive index n1 greatest by the optical compensating plate 22 has been arranged are arranged. Therefore, in the direction in which the big refractive index n2 is arranged by the optical compensating plate 22 the 2nd, the greatest refractive index n1 is arranged by the optical compensating plate 26.

[0014] If the optical compensating plates 22 and 26 are doubled and considered, the refractive indexes of the direction of a x axis are n1 and n2, and the refractive indexes of the direction of y will be n2 and n1, and will become almost homogeneous [the optical property of field inboard]. Moreover, the refractive index of z shaft orientations is the minimum refractive index n3, and constitutes negative optical activity as the optical compensating plate 22 and the 26 whole.

[0015] The rectangular polariscopes 21 and 27 are arranged on the outside of these optical compensating plates 22 and 26. The polarization shafts P1 and P2 of these polariscopes 21 and 27 are arranged in the direction which has the angle of 45 degrees in a x axis and the y-axis.

[0016] Thickness is selected so that the optical compensating plates 22 and 26 may produce the phase contrast (retardation) of wavelength about the polarization component of the direction of a x axis, and y shaft orientations, respectively (1/4) preferably.

[0017] The combination of a linear polariscope and a wavelength plate (1/4) constitutes a circular polarization of light machine. Moreover, if the composition which the size of the refractive index of field inboard reversed like the optical compensating plates 22 and 26 has dextro-rotatory one side, it will become levo-rotatory [another side].

[0018] Drawing 5 shows other gestalten of the optical compensation mechanism in which an angle of visibility is expanded. The point that substrates 13 and 15 are arranged on both sides of the liquid crystal layer 14, and constitute a liquid crystal cell 12 and the rectangular polariscopes 21 and 27 are arranged on the outside of a liquid crystal cell 12 is the same as that of the case of drawing 4 .

[0019] In this composition, the retardation board 32 arranged between a liquid crystal cell 12 and a polariscope 21 consists of optically uniaxial material which has an optical axis in field inboard (the direction of a x axis).

[0020] Moreover, the retardation board 36 arranged between a liquid crystal cell 12 and a polariscope 27 consists of optically uniaxial media which have an optical axis in the field inboard (y shaft orientations) which intersects perpendicularly. In addition, the arrow within the field of the retardation boards 32 and 36 shows the extension direction in a manufacturing process.

[0021] If the retardation boards 32 and 36 are considered collectively, the retardation boards 32 and 36 constitute the optical medium which has negative optical activity as a whole. Moreover, if the retardation boards 32 and 36 are made into the thickness which gives the phase contrast (retardation) of wavelength, respectively (1/4), the combination of a polariscope 21 and the retardation board 32 constitutes a dextro-rotatory circular polarization of light machine, and the combination of the retardation board 36 and a polariscope 27 constitutes a levo-rotatory circular polarization of light machine.

[0022] Since the composition of drawing 4 needs an optically-biaxial optical material, the manufacture process complicates it. On the other hand, since the composition of drawing 5 can be constituted using an optically uniaxial optical material, the manufacture process becomes easy.

[0023] If three above-mentioned composition is compared only within the field where contrast becomes 5:1 about an angle of visibility, in the composition of drawing 3 , an angle of visibility will become about 25 degrees in the composition of drawing 5 about 30 degrees about 50 degrees in the composition of drawing 4 . Moreover, in the case of drawing 3 , in the case of drawing 4 , the permeability to the vertical-incidence light of all composition becomes about 2.5% about 2.5% about 1.5% in the case of drawing 5 .

[0024] That is, for an angle of visibility, when a liquid crystal cell is compensated with the optical compensating plate which has the negative optical activity of one sheet shown in drawing 3 , permeability is a low although it becomes large.

[0025] If a circular polarization of light machine is constituted combining a linear polariscope, an optical compensating plate, or a retardation board like drawing 4 and drawing 5 and it arranges on both sides of a liquid crystal cell, permeability will increase about 50% or more. However, an angle of visibility will become narrow.

[0026] Moreover, in the composition of drawing 3 - drawing 5 , what it is the easiest to manufacture is the composition

of drawing 5 , and an angle of visibility will become still narrower in this case.
[0027]
[Problem(s) to be Solved by the Invention] According to the Prior art, an angle of visibility is large and it was hard to acquire the optical compensation means for perpendicular array-type liquid crystal displays by which permeability is high.
[0028] The purpose of this invention is offering the perpendicular array-type liquid crystal display equipped with an optical compensation means the optical performance of a liquid crystal display being improvable.
[0029] Other purposes of this invention are offering the possible optical compensator for perpendicular array-type liquid crystal displays of raising permeability, without manufacture constituting a circular polarization of light machine, and reducing an angle of visibility using an easy optical member.
[0030]
[Means for Solving the Problem] The liquid crystal cell which has the positive optical activity which a nematic liquid crystal arranges mostly the perpendicular array-type liquid crystal display of this invention to a perpendicular in the state where electric field are not impressed at a substrate, and uses a direction perpendicular to a substrate as an optical axis, An optical compensation means to have the negative optical activity which adjoins a liquid crystal cell, is arranged and uses a direction perpendicular to a field as an optical axis, The 1st retardation board which it is arranged [board] at one aforementioned liquid crystal cell side, has [board] the positive optical activity within a field parallel to the aforementioned substrate which uses ** as an optical axis on the other hand, and produces the phase contrast of wavelength mostly (1/4), The 1st polariscope which is arranged outside the 1st retardation board and has a polarization shaft in a field parallel to the aforementioned substrate in the direction which makes the optical axis of the aforementioned 1st retardation board, and the angle of about 45 degrees, It is arranged at the another side side of the aforementioned liquid crystal cell, and has the negative optical activity which uses an almost parallel direction as an optical axis to the optical axis of the aforementioned 1st retardation board in a field parallel to the aforementioned substrate. It is arranged outside the 2nd retardation board which produces the phase contrast of wavelength mostly (1/4), and the aforementioned 2nd retardation board, and has the 2nd polariscope which has a polarization shaft in the direction which intersects perpendicularly with the polarization shaft of the 1st polariscope of the above mostly in a field parallel to the aforementioned substrate.
[0031] Moreover, the optical compensator for liquid crystal displays of this invention With the board of the optically uniaxial optical medium of the couple arranged on central structure including an optical compensation means to have the negative optical anisotropy which uses as an optical axis a direction perpendicular to the substrate and field of the couple which demarcates the space in which liquid crystal can be held, and the aforementioned central structure One side has the positive optical activity within a field which uses ** as an optical axis on the other hand, and another side includes a phase shift means to have the negative optical activity which uses a direction parallel to the one aforementioned direction as an optical axis.
[0032]
[Function] The 2nd retardation board and the 2nd polariscope which constitute the 1st circular polarization of light machine, and have the direction of an optical axis in a field with the 1st retardation board and the 1st polariscope which have the direction of an optical axis in a field constitute the 2nd circular polarization of light machine. The permeability of the whole liquid crystal display can be improved by this composition.
[0033] Moreover, the 1st retardation board is constituted from material which has positive optical activity, and the 2nd retardation board consists of material which has negative optical activity.
[0034] An angle of visibility can be maintained at a big value by combining these circular polarization of light machines with an optical compensation means, and using them.
[0035]
[Example] The liquid crystal display by the example of this invention is shown in drawing 1 . A liquid crystal cell 10 holds the nematic-liquid-crystal layer 4 among the substrates 3 and 5 of a couple. The liquid crystal molecule 8 of a nematic liquid crystal has a high refractive index in the direction of a major axis. In the state of electric-field OFF, the liquid crystal molecule 8 is mostly arranged to substrates 3 and 5 at a perpendicular.
[0036] Setting in this state, the liquid crystal layer 4 is the refractive index neLC high in a direction perpendicular to substrates 3 and 5. It has and is the refractive index noLC uniform to substrate side inboard, and low. It has. That is, the liquid crystal layer 4 has positive optical activity.
[0037] The optical compensating plate 8 which has a negative optically uniaxial optical anisotropy with the small refractive index of a field and the perpendicular (Z) direction in one liquid crystal cell 10 side is arranged. The negative optical anisotropy of this optical compensating plate 8 compensates the positive optical anisotropy of the liquid crystal layer 4.

[0038] The retardation boards 2 and 6 are arranged on the outside of a liquid crystal cell 10 and the optical compensating plate 8. The retardation board 2 is the refractive index ne higher on the other hand than other directions of [within a field] to ** (the direction of a x axis). It has the optically uniaxial optical anisotropy which it has. Moreover, the retardation board 6 is the refractive index ne lower than other directions in the direction of a x axis which is the same direction as the above-mentioned direction of an optical axis. It consists of optically uniaxial optical media which it has.

[0039] That is, the retardation board 2 has the positive optical activity which has an optical axis in the direction of a x axis, and the retardation board 6 has the negative optical activity which has an optical axis in the direction of a x axis. The retardation of both the optical compensating plates 2 and 6 disappears as the whole. The rectangular polariscopes 1 and 7 of a couple are arranged on the outside of the retardation boards 2 and 6. The polarization shafts P1 and P2 of these polariscopes 1 and 7 are arranged in the direction which makes the angle of 45 degrees to a x axis and the y-axis, respectively.

[0040] to the retardation board of the envelope polariscope of the couple by the Prior art carrying out rectangular arrangement of the thing of the same property, the retardation board of this example arranges the direction of an optical axis, and arranges the optically uniaxial medium which has the property which is reverse

[0041] The thickness of the retardation boards 2 and 6 is chosen so that the phase contrast (retardation) of wavelength (1/4) may be produced preferably. (1/4) When producing the phase contrast of wavelength, the linear polariscope 1 and the retardation board 2 constitute a dextro-rotatory circular polarization of light machine, and the retardation board 6 and the linear polariscope 7 constitute a levo-rotatory circular polarization of light machine.

[0042] Drawing 2 is a schematic diagram for explaining operation of the liquid crystal display of drawing 1 . The light which carries out incidence to a polariscope 1 from the exterior is changed into linear polarization by the polariscope 1. Since the polarization shaft P1 of a polariscope 1 has the angle of 45 degrees to the direction of a x axis, and y shaft orientations, if the polarization component of the direction of a x axis and y shaft orientations is considered, as shown in drawing 2 (A), the polarization component of in phase and equal intensity will be obtained.

[0043] If a retardation board with the high refractive index of the direction of a x axis is selected so that the phase contrast of wavelength (1/4) may be produced for the thickness of through and a retardation board, about the light after passing a retardation board, the polarization component of the direction of a x axis will be overdue by wavelength (1/4) to the polarization component of y shaft orientations.

[0044] That is, if the polarization component of the direction of a x axis is overdue wave (1/4) length as shown in drawing 2 (B), a polarization component will serve as the circular polarization of light rotated in a field as shown in the left-hand side in drawing.

[0045] When the refractive index of the direction of a x axis is low, the polarization component of y shaft orientations is late for the case of drawing 2 (B), and reverse to the polarization component of the direction of a x axis. For this reason, the polarization components Ex and Ey as shown in drawing 2 (C) are obtained, and the light as these composition rotates in a field, as shown in the drawing 2 (C) left-hand side.

[0046] By such composition, permeability can be made high with about 2.5%, making an angle of visibility large with about 50 degrees.

[0047] For example, the retardation board 2 which has positive optical activity is formed by the polycarbonate film extended to ** on the other hand. The thickness of this polycarbonate film is chosen so that the phase contrast of wavelength (1/4) may be produced.

[0048] Moreover, the retardation board 6 which has negative optical activity consists of polymethylmethacrylate (PMMA) films extended to 1 shaft orientations. It is chosen so that the thickness of this retardation board 6 may also produce the phase contrast of wavelength (1/4). Distribution of the refractive index of such material is 5% or less in a 440 to 700nm visible region.

[0049] Moreover, the value of the parasitism permeability T which may be produced by distribution of a refractive index becomes T<sin2, i.e., (0.0125pi), T< 0.2%, and can be restricted to what hardly affects operation as this seed display.

[0050] Although this invention was explained in accordance with the example above, this invention is not restricted to these. for example, various change, improvement, combination, etc. are possible -- this contractor -- obvious -- it will be .

[0051]

[Effect of the Invention] As explained above, according to this invention, manufacture is easy, an angle of visibility is large, and a liquid crystal display with high permeability is offered.

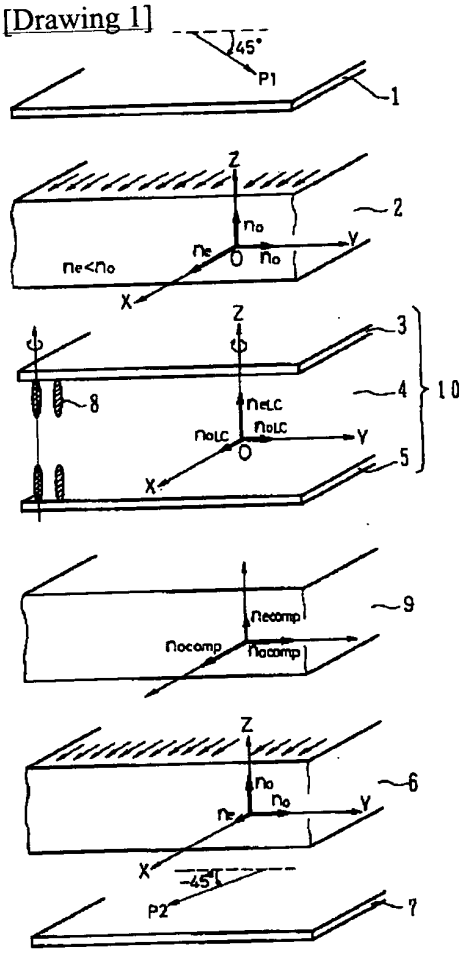
[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

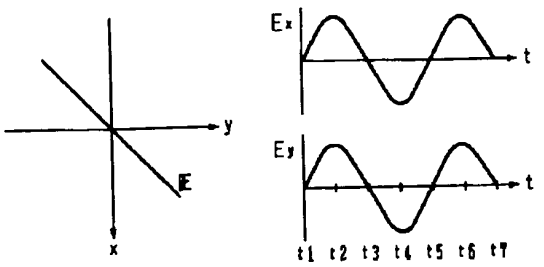
DRAWINGS

[Drawing 1]

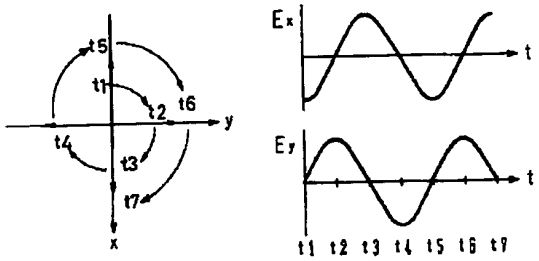


[Drawing 2]

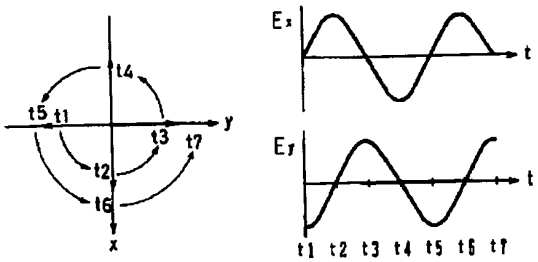
(A) リニア偏光器



(B) (1/4)波長板

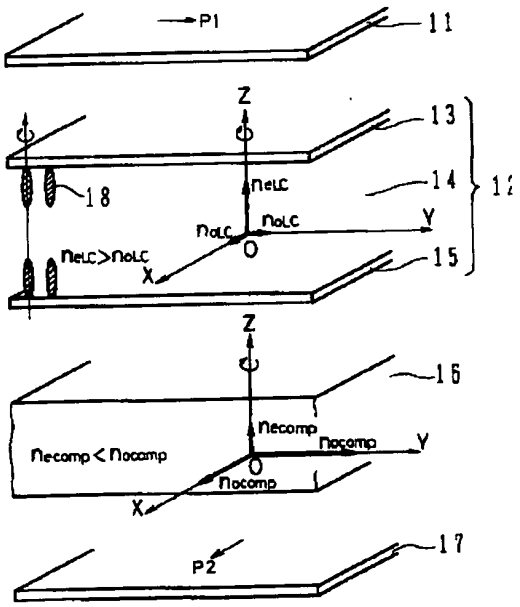


(C) (1/4)波長板



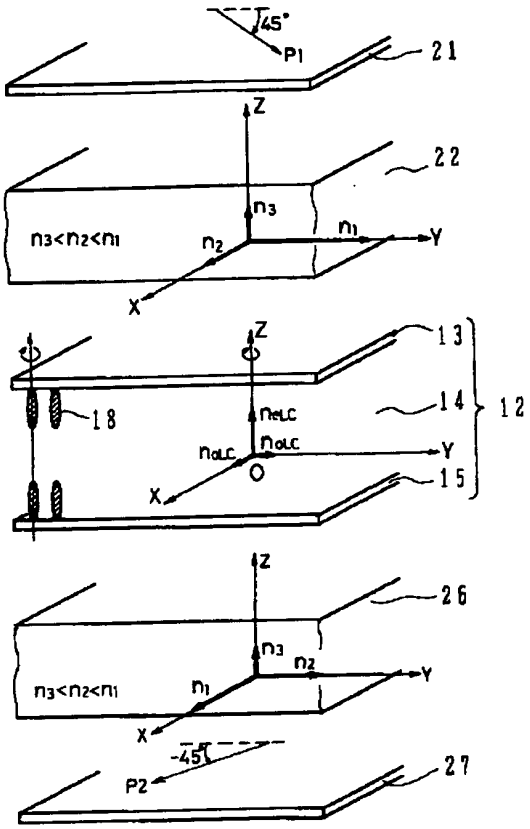
[Drawing 3]

従来技術



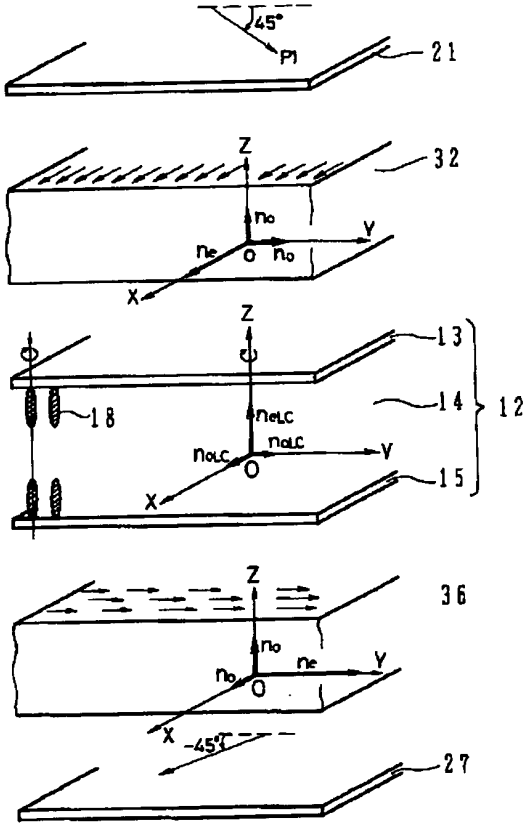
[Drawing 4]

従来技術



[Drawing 5]

従来技術



[Translation done.]